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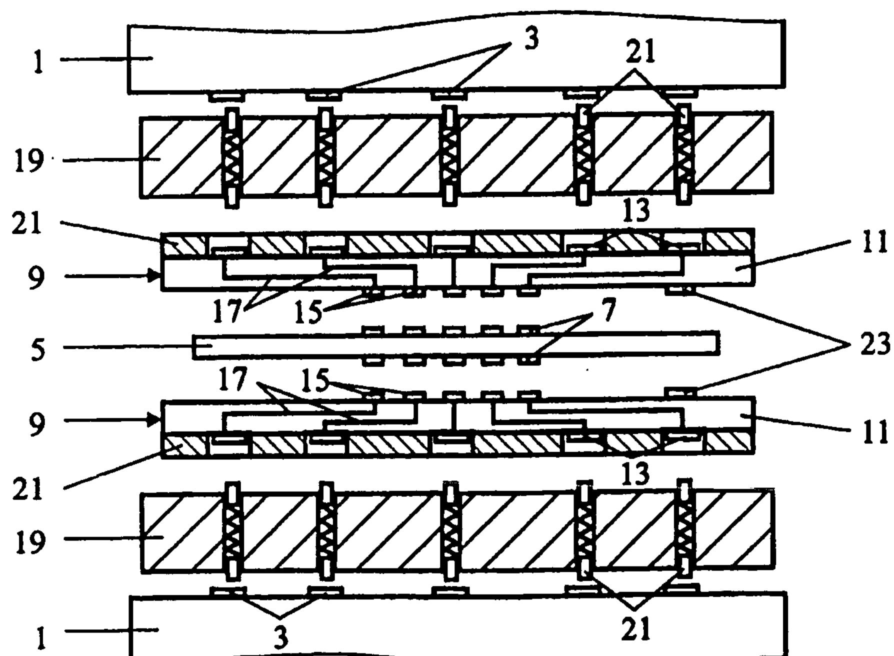
(54) Title: METHOD FOR THE MANUFACTURE OF A TEST ADAPTER AS WELL AS TEST ADAPTER AND A METHOD FOR THE TESTING OF PRINTED CIRCUIT-BOARDS

(57) Abstract

Method for the manufacture of a test adapter (9; 57) for the electrically conductive connection of measuring surfaces (3) present in a test installation (1) to test surfaces (7) present on a printed circuit-board (5) to be tested, the test adapter (9; 57) having a substrate (11; 55) with, on one side, first contact surfaces (13; 65) corresponding to the measuring surfaces (3) configuration and, on the other side, second contact surfaces (15; 67) corresponding to the test surfaces (7) configuration, whereby electrically conductive tracks (17; 63) are applied onto and through contacts (25; 69, 71) are made in the substrate (11; 55) to connect the first and second contact surfaces to one another electrically, characterised in that one or more of the electrically conductive elements, comprising the through contacts (25; 69, 71), the electrically conductive tracks (17; 63), the first contact surfaces (13; 65) and the second contact surfaces (15; 67), are applied in respectively onto the substrate (11; 55) using printing techniques.



Method for the manufacture of a test adapter as well as test adapter and a method for the testing of printed circuit-boards.

DESCRIPTION:

FIELD OF THE INVENTION

The invention concerns a method for the manufacture of a test adapter for the electrically conductive connection of measuring surfaces present in a test installation to test surfaces present on a printed circuit-board to be tested, the test adapter having a substrate with, on one side, first contact surfaces corresponding to the measuring surfaces configuration and, on the other side, second contact surfaces corresponding to the test surfaces configuration, whereby electrically conductive tracks are applied onto and through contacts are made in the substrate to connect the first and second contact surfaces to one another electrically. Such test adapters are used for measuring substrates with printed wiring, so-called printed circuit-boards (PCBs). The term PCBs includes all boards having electrically conductive tracks, irrespective of the method by which these tracks have been formed and applied, thus not only printed tracks. PCBs are used in virtually all electrical equipment. The term test surfaces refers not only to special surfaces, for example surfaces upon which components are located, but also to arbitrary locations on the electrically conductive tracks. Contact surfaces means the three-dimensional forms that are printed on a substrate, in other words these forms, as well as possessing width and length also possess height or thickness.

BACKGROUND OF THE INVENTION

Due to the continuing miniaturisation in the electronics field PCBs are becoming smaller and smaller, and the track density of the electrically conductive tracks that form the wiring is continually increasing. Before these PCBs can be used they first have to be checked for, among other things, the presence of undesired short circuits between the tracks as well as for breaks in the applied tracks. Test installations exist for the

checking of PCBs. These test installations consist of measuring surfaces that are connected to the test surfaces of the PCB to be tested via a test adapter. Because a separate test adapter is needed for each different track pattern, and because there are so many different PCBs in the electronics industry, an enormous number of test adapters are required. Also, because the track density, and consequently the density of the test surfaces on the PCB, continues to increase, test adapters can no longer be produced economically. Other test methods exist, but these are either too expensive or the method involved in testing consumes so much time as to make them uneconomic. This inability to test at reasonable cost is the great unsolved problem of the moment.

SUMMARY OF THE INVENTION

An objective of the invention is the provision of a method for the manufacture of a test adapter as described at the beginning, whereby PCBs with high density and small test surface dimensions can be tested at reasonable cost. For this, the method according to the invention is characterised in that one or more of the electrical elements, comprising the through contacts, the electrically conductive tracks, the first contact surfaces and the second contact surfaces, are applied in respectively onto the substrate using printing techniques. The use of printing techniques enables extremely small tracks and extremely small, high-density contact surfaces to be applied to a substrate at relatively low cost. Printing techniques are well-known, but their use in the manufacturing of test adapters is new. For the present day level of technique, in which the test surfaces on the PCB to be tested are very small with an extremely high density, it was not considered feasible to use printing techniques for the manufacture of test adapters. During the renowned international research projects into this specific problem of manufacturing test adapters at reasonable cost, as carried out by the EIPC Bare Board Test Working Group under H. Pietruschka and by the T^4 BBT Work Group under C. Vaucher, diverse techniques for the manufacture of test adapters were looked into. However, at the moment no-one has been able to develop methods whereby tests on PCBs of such high density can be carried at sufficiently high speed and at economically viable cost.

Because the manufacture of test adapters using printing techniques was considered unachievable, developments in this field came to a virtual standstill. The present

invention is based on thc view that, using printing techniques, it is indeed possible to achieve these high densities and small dimensions. The manufacture of a test adapter with such high density and small contact surface dimensions using printing techniques is entirely new. That it is not obvious that such test adapters can be made using printing techniques should be sufficiently clear from the aforementioned state of techniques in the field of test adapter manufacturing.

A further enormous advantage of the method according to the invention is that, with this method, no residues or waste are created, making it extremely environmentally friendly.

The silk screen printing technique is one method that could be used in the printing process. For preference, however, printing is carried out by placing a template on the substrate, the template having various apertures through which an electrically conductive material is applied, followed by the removal of the template. Using this template-printing technique even smaller dimensions and higher densities can be achieved than by using the silk screen printing process. A copper or silver paste can be used as an electrically conductive material.

Constructional advantages of the method according to the invention are characterised by the fact that, using the printing technique, contact surfaces can be produced on the substrate with dimensions of 100 μm or less and by the fact that, using the printing technique, contact surfaces can be produced on the substrate having a density of 30 contact surfaces per cm² or higher. With these small dimensions and high densities, the existing techniques for the manufacture of test adapters are too expensive to allow the testing of PCBs to be carried out at reasonable cost. The main advantage of this method is that the testing of PCBs is cost effective.

Further constructional advantages are characterised by the fact that, using the printing technique, contact surfaces are produced up to 120 μm high (thick) and by the fact that contact surfaces can be produced having an angle between the side walls and the substrate of 60° or more. Because the PCBs to be tested are never entirely flat, the test adapter substrate can never be completely flat and the contact surfaces are not all of the same height, high contact surfaces are desirable so that, during the pressing of the test adapter against the PCB under test, sufficient elastic springing of the contact surfaces is possible so as to guarantee contact of every contact surface with the measuring or test

surfaces.

Due to the fact that test surface density has increased dramatically, the present through contacts of substrates are also no longer adequate because of the demand for smaller through contact diameters than can be produced using the known techniques. This problem is also solved by a further constructional feature of the test adapter according to the invention. Through contacts are formed by producing holes in the substrate after which a negative pressure is applied to the first side of the substrate while, on the other side of the substrate, electrically conductive material is printed into the holes. Through this negative pressure, preferably a vacuum, the material is drawn into the extremely small holes, thus filling them up and creating the through contacts. The application of the electrically conductive material also occurs through the use of printing techniques.

In order to prevent the conductive material being drawn right through and out of the holes in the substrate, a further constructional feature is the application of a gas permeable membrane to the first side of the substrate.

In order to produce the through contacts, holes have first to be made in the substrate. These holes must not be too conical in section otherwise the chance is that the diameter on one of the surfaces will be too great. An advantageous method of producing these extremely fine holes is laser drilling. Using this technique, holes are drilled through the substrate having dimensions of 50 μm or less and a hole wall angle of 60° or more.

A further constructional feature allows the hardening of the applied shapes, such as contact surfaces and electrically conductive tracks, to be carried out in a sufficiently speedy and good manner. After the printing of the electrically conductive material in and/or on the substrate, the material is dried at a temperature between 100 and 150°C.

The invention also concerns a test adapter manufactured according to a method of the invention, for the electrically conductive connection of measuring surfaces present in a test installation to test surfaces present on a printed circuit-board to be tested, having a substrate with, on one side, first contact surfaces corresponding to the measuring surfaces configuration and, on the other side, second contact surfaces corresponding to the test surfaces configuration whereby the first and second contact surfaces are connected to one another electrically via electrically conductive tracks and through contacts. To enable the testing of PCBs with extremely high track density, a characteristic of the test adapter according to the invention is the fact that the through contacts are printed into the substrate

and/or that one or more of the electrically conductive elements, comprising the electrically conductive tracks, the first contact surfaces and the second contact surfaces, are printed on the substrate.

For preference, at least a number of the contact surfaces have dimensions of 100 μm or less and a contact surface density of 30 contact surfaces per cm^2 or higher.

As already stated in the description of the method, it is also advantageous that at least a number of the contact surfaces have a height of 80 to 120 μm. Furthermore, it is also favourable that, in at least a number of the contact surfaces, the side walls are at an angle of 60° or more to the substrate, and that at least a number of the laser-drilled through holes in the substrate have dimensions of 50 μm or less and hole wall angles of 60° or more.

It is an advantage for laser drilling if the substrate material contains no glass fibres. Because the electrically conductive material should preferably be hardened at a temperature between 100 and 150°C, it is also advantageous for the substrate material to have a softening temperature of more than 150°C.

The invention also concerns a method for the testing of printed circuit-boards whereby use is made of a test adapter according to the invention, and whereby a printed circuit-board to be tested, provided with test surfaces, is placed between two parts of a test installation, provided with measuring surfaces, and whereby at least one test adapter, provided with contact surfaces, is placed between the printed circuit-board and the test installation for the electrical connection of the test surfaces with the measuring surfaces, after which both parts of the test installation are brought together and the contact surfaces make contact with the test and measuring surfaces. With the known methods for the testing of PCBs, spring elements are used to produce contact between the contact surfaces of the test adapters and the PCB measuring surfaces, mainly on or underneath the contact surfaces such as, for example, small electrically conductive springs on the contact surfaces, or contact surfaces on elastic foil with cut-outs in the substrate underneath the contact surfaces. These spring elements complicate the construction of the test adapter and, as far as miniaturisation is concerned, are unable to keep pace with the continuing miniaturisation of the PCBs to be tested. This miniaturisation of the test surfaces, and the subsequent need for the reduction in size of the test adapter contact surfaces, leads to large, and up to now, insoluble problems with regard to the construction of these spring elements.

Another objective of the invention is the provision of a method for the testing of PCBs as described above, whereby correct contact between the test adapter and the PCB under test is obtained. To this end, the method for the testing of PCBs according to the invention is characterised by the fact that a uniform pressure is applied to the test adapter causing elastic deformation through which the contact surfaces of the test adapter are brought into contact with the test surfaces of the printed circuit-board to be tested. By making use of the elastic (mainly compressibility) qualities of the test adapter, the so-called stamp effect, no extra spring elements are required, which eliminates the problem of miniaturisation of the spring elements. This is a totally new approach to the testing of PCBs, which previously used spring elements. The normal, existing materials remain adequate for the production of test adapters. These already possess sufficient elasticity.

A constructional characteristic of the method for the testing of PCBs according to the invention is the placing of a pressure plate between the test installation and the test adapter, which allows the uniform transfer of pressure. This guarantees a uniform pressure force and ensures that all contact surfaces make contact with the test surfaces.

In order to ensure that an adequate pressure force exists, a further constructional characteristic is that the pressure with which the test adapter is pressed against the printed circuit-board under test is measured by at least one pressure sensor.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be further explained below with the aid of drawings showing construction examples of the test adapter according to the invention.

These indicate:

Figure 1 is a schematic drawing of the test installation with adapters, pressure plates and PCBs to be tested;

Figure 2 is a cross-section of a first constructional form of a test adapter according to the invention;

Figure 3 is a view of a test adapter contact surface;

Figure 4 shows a stage in the method according to the invention in which through contacts are produced in the test adapter substrate;

Figure 5 is a stage in the method according to the invention in which holes

are drilled in the substrate;

Figure 6 is a cross-section of a second constructional form of a test adapter according to the invention;

Figure 7 is a top view of a template for the application of a layer of the test adapter's track pattern; and

Figure 8 is a further stage in the method according to the invention in which electrically conductive tracks are applied.

DETAILED DESCRIPTION OF PREFERED EMBODIMENTS

Figure 1 shows a test set-up for the testing of PCBs. The test set-up contains a test installation 1, provided with measuring surfaces 3. In this example, the PCB 5 to be tested is a double-sided printed PCB with test surfaces 7 on each side. The test surfaces 7 have a different configuration to the measuring surfaces 3 and have a much greater density than the measuring surfaces. Between each side of the PCB 5 and the test installation 1 is a test adapter 9 for connecting the test surfaces 7 with the measuring surfaces 3. The test adapter 9 consists of a substrate 11 with, on one side, first contact surfaces 13 corresponding with the configuration of the measuring surfaces 3 and, on the other side, second contact surfaces 15 corresponding with the configuration of test surfaces 7. The first and second contact surfaces are connected to one another electrically via electrically conductive tracks 17. Between the test adapters 9 and the test installation 1 are units 19 with spring loaded compensation pins 21, which electrically connect the first contact surfaces 13 with the measuring surfaces 3, and take up any possible differences in height. These units 19 are needed mainly to bridge the gap between the two parts of the existing test installation 1 and the test adapters 9. The units could be discarded if working with new test installations specially designed for the new test methods. For testing, both the indicated parts of the test installation 1 are brought together whereby the second contact surfaces 15 of the test adapters 9 are pressed against the test surfaces 7. The closure force needs to be sufficiently high and uniform to ensure that all test surfaces 7 make contact with the second contact surfaces 15. This is achieved by placing pressure plates 21 between the test adapters 9 and the units 19 or, in the absence of the units, test installation 1. These pressure plates 21 need to be extremely rigid, and to this end are made, for example, from solid aluminium.

The test adapters are elastically deformed under the pressure, causing the contact surfaces 15 to be pressed against test surfaces 7. In order to ensure that a sufficiently high pressure is applied, the pressure between the test adapters 9 and the PCB 5 under test is measured by pressure sensors 23.

Figure 2 shows a cross-section of a first form of construction for the test adapter 9. The second contact surfaces 15 are printed on the underside of the substrate 11. The electrically conductive tracks 17 and the first contact surfaces 13 are printed on the upper side. Through contact is made with the substrate 11 via the second contact surfaces 15. These through contacts 25 are produced by pressing electrically conductive material into the holes in the substrate 11. This will be explained further in figure 4.

Figures 1 and 2 give a schematic representation of the contact surfaces. Figure 3 shows a measured form of a contact surface 15. The contact surface's three-dimensional shape is indicated. With the method according to the invention, contact surface dimensions -here meaning dimension 27 of the two-dimensional upper surface - of less than 100 μm can be achieved. Dimension 27 of the contact surface 15 shown is approximately 50 μm. A density of 30 contact surfaces per cm^2 and more can be achieved with this method. The height 29 of the contact surface 15 shown is approximately 100 μm. Heights of 120 μm and more have already been measured. With this height and using the method according to the invention, an angle 31 of 60° and more can be achieved between the side wall 33 and the contact surface 15. The angle 31 of the contact surface shown is approximately 75°.

Figure 4 shows the method stage in which the through contacts 25 are produced. Prior to this, holes 35 are made in the substrate 11. These holes are drilled by laser. This will be described further in figure 5. For the through contacts, a gas permeable membrane 37 is fitted to the underside of the substrate 11. The space 39 beneath the substrate 11 is under vacuum. A template 41 is then placed on the substrate 11, with a number of apertures 43 located at the positions of the holes 35. An electrically conductive material 47, for example a paste with a conductive polymer or a silver paste, is printed through the apertures 43 into the holes 35 using a squeegee 45. The vacuum present at the underside draws the electrically conductive material 47 into the holes 35, thus improving the filling of the holes. The membrane 37 ensures that the electrically conductive material is not drawn completely through the holes 35.

Figure 4 gives a schematic representation of the holes 35. Figure 5 shows the actual shape of one of the holes. The hole 35 is drilled in the substrate 11 using a laser beam 49. Because the laser beam 49 diverges relative to the depth that has to be drilled, the hole 35 is conical in form. The hole wall 51 of the hole 35 is therefore at an angle 53 of 75° to the substrate 11 surface. The wall 51 should be as steep as possible so that the diameter on the underside, and therefore the surface area of the through contact to be produced, is as small as possible. Steeper angles can be achieved by using a substrate 11 material that is free of glass fibres, which means that the laser beams cannot be deflected by glass fibres.

Figure 6 shows a cross-section of a second constructional form of the test adapter according to the invention. The substrate 55 of the test adapter 57 is made up of two plates 59 and 61, between which are located the electrically conductive tracks 63. On one side of the substrate 55 are the first contact surfaces 65, which correspond to the configuration of the measuring surfaces 3. On the other side are the second contact surfaces 67, which correspond with the configuration of the test surfaces 7. The contact surfaces 65 and 67 are connected to the tracks 63 via through contacts 69 and 71. The electrically conductive tracks 63 are in various layers 73 on top of one another. The space 75 between the tracks 63 in one layer is filled with insulation material. Between these layers 73 are insulation layers 77 which, in a number of places, are provided with through contacts 79. The topmost plate 61 can eventually be left out. However, in that case the through contact locations on the upper insulation layer should preferably be heightened so as to improve contact with the measuring surfaces.

The method for the manufacture of the test adapter according to the invention, showing principally the printing technique, will be described with the aid of figures 7 and 8. Firstly, holes are drilled in the substrate at the positions where the through contacts are to be located, as previously described with the aid of figure 5. After the holes have been made they are filled with, for example, a silver paste, as previously described with the aid of figure 4. Next, an electrically conductive track pattern is printed on the substrate in one or more layers. Figure 2 shows a test adapter with the tracks in one layer while figure 6 shows a test adapter with tracks in more than one layer. The tracks, and eventual through contacts in the insulation material between the tracks, are applied using a printing technique whereby an electrically conductive material is printed onto the substrate through apertures in a template.

Figure 7 shows an example of such a template 81. The template 81 is an extremely thin stainless metal plate 83 which is provided with apertures 85. The apertures 85 are produced, for example, by laser cutting or laser drilling. The thickness of the template 81 determines the thickness, or height, of the tracks or contact surfaces to be produced. Templates as thin as 25 µm can be used.

The template 81 is then positioned on the substrate 87. This positioning has to be extremely accurate and for preference should be done mechanically with the aid of image analysis techniques. An electrically conductive material 91, a copper paste for example, is then spread through the apertures 85 using a squeegee 89. It may be desirable to make a number of spreading passes with the squeegee. This is also preferably done by mechanical means. The template 81 is then removed and the paste hardened at a temperature between 100 and 150°C. The material of the substrate should therefore preferably have a softening temperature of more than 150°C.

The contact surfaces are also printed on the substrate in the manner described above.

Although the above describes the invention using the drawings, it should be pointed out that the invention is in no way limited to the constructional form indicated on the drawings. The invention is open to different constructional forms, within the framework of the defined conclusions, other than the forms of construction indicated on the drawings.

CLAIMS:

1. Method for the manufacture of a test adapter (9; 57) for the electrically conductive connection of measuring surfaces (3) present in a test installation (1) to test surfaces (7) present on a printed circuit-board (5) to be tested, the test adapter (9; 57) having a substrate (11; 55) with, on one side, first contact surfaces (13; 65) corresponding to the measuring surfaces (3) configuration and, on the other side, second contact surfaces (15; 67) corresponding to the test surfaces (7) configuration, whereby electrically conductive tracks (17; 63) are applied onto and through contacts (25; 69, 71) are made in the substrate (11; 55) to connect the first and second contact surfaces to one another electrically, characterised in that one or more of the electrically conductive elements, comprising the through contacts (25; 69, 71), the electrically conductive tracks (17; 63), the first contact surfaces (13; 65) and the second contact surfaces (15; 67), are applied in respectively onto the substrate (11; 55) using printing techniques.

2. Method in accordance with claim 1, characterised in that the printing takes place through the placing of a template (41; 81) on the substrate (11; 87), the template having various apertures (43; 85) through which an electrically conductive material (47; 91) is applied, followed by the removal of the template.

3. Method in accordance with claim 1 or 2, characterised in that at least a number of the contact surfaces (15; 67) produced on the substrate (11; 55) using the printing technique have dimensions (27) of 100 μm or less.

4. Method in accordance with claim 1, 2 or 3, characterised in that at least a number of the contact surfaces (15; 67) produced on the substrate (11; 55) using the printing technique achieve a density of 30 contact surfaces per cm^2 and higher.

5. Method in accordance with claim 1, 2, 3 or 4, characterised in that the contact surfaces (13, 15; 65, 67) produced using the printing technique have a height (29) up to 120 μm.

6. Method in accordance with claim 1, 2, 3, 4, or 5, characterised in that the angle of slope (31) between the substrate and the side walls (33) of the contact surfaces (13, 15; 65, 67) produced using the printing technique is 60° or more.

7. Method in accordance with one of the above claims, characterised in that the through contacts (25; 69, 71) are formed by producing holes (35) in the substrate (11; 55) after which a negative pressure is applied to the first side of the substrate while, on the other

side of the substrate, electrically conductive material (47) is printed into the holes.

8. Method in accordance with claim 7, characterised in that a gas-permeable membrane (37) is applied to the first side of the substrate (11) in order to avoid the conductive material (47) being drawn through the holes (35) in the substrate.

9. Method in accordance with one of the above claims, characterised in that, for the through contacts (25; 69, 71), holes (35) are first drilled through the substrate (11; 55) by laser, the holes (35) having dimensions of 50 μm or less and a wall angle (53) of 60° or more.

10. Method in accordance with one of the above claims, characterised in that, after the printing of the electrically conductive material in and/or on the substrate, the material is dried at a temperature between 100 and 150°C.

11. Test adapter manufactured, in accordance with a method of one of the above claims, for the electrically conductive connection of measuring surfaces (3) present in a test installation (1) to test surfaces (7) present on a printed circuit-board (5) to be tested, having a substrate (11; 55) with, on one side, first contact surfaces (13; 65) corresponding to the measuring surfaces (3) configuration and, on the other side, second contact surfaces (15; 67) corresponding to the test surfaces (7) configuration, whereby the first and second contact surfaces are connected to one another electrically via electrically conductive tracks (17; 63) and through contacts (25; 69, 71), characterised in that the through contacts (25; 69, 71) are printed into the substrate and/or one or more of the electrically conductive elements, comprising the tracks (17; 63), the first contact surfaces (13; 65) and the second contact surfaces (15; 67), are printed onto the substrate.

12. Test adapter in accordance with claim 11, characterised in that at least a number of the contact surfaces (15; 67) have dimensions (27) of 100 μm or less.

13. Test adapter in accordance with claim 11 or 12, characterised in that at least a number of the contact surfaces (15; 67) achieve a densitie of 30 contact surfaces per cm^2 or higher.

14. Test adapter in accordance with claim 11, 12 or 13, characterised in that at least a number of the contact surfaces (13, 15; 65, 67) have a height (29) of 80 to 120 μm.

15. Test adapter in accordance with claim 11, 12, 13 or 14, characterised in that, at least for a number of contact surfaces (13, 15; 65, 67), the angle (31) between the substrate and the side walls is 60°or more.

16. Test adapter in accordance with claim 11, 12, 13, 14 or 15, characterised in that at least a number of the laser-drilled holes (35) through the substrate have dimensions of 50 μm or less and the hole walls have an angle (53) of 60° or more.

17. Test adapter in accordance with claim 11, 12, 13, 14, 15 or 16, characterised in that the substrate (11; 55) is made of a material containing no glass fibres and has a softening temperature of more than 150°C.

18. Method for the testing of printed circuit-boards using a test adapter in accordance with one of the above claims and whereby a printed circuit-board (5) to be tested, provided with test surfaces (7), is placed between two parts of a test installation (1), provided with measuring surfaces (3), and whereby at least one test adapter (9; 57), provided with contact surfaces (13, 15; 65, 67), is placed between the printed circuit-board (5) and the test installation (1) for the electrical connection of the test surfaces with the measuring surfaces, after which both parts of the test installation (1) are brought together and the contact surfaces (13, 15) make contact with the test and measuring surfaces (3, 7), characterised in that a uniform pressure is applied to the test adapter (9) causing elastic deformation through which the contact surfaces (13, 15) of the test adapter (9) are brought into contact with the test surfaces (7) of the printed circuit-board (5) to be tested.

19. Method in accordance with claim 18, characterised in that a pressure plate (21) is placed between the test installation (1) and the test adapter (9) through which a uniform pressure is applied.

20. Method in accordance with claim 18 or 19, characterised in that the pressure with which the test adapter (9) is pressed against the printed circuit-board (5) to be tested is measured by at least one pressure sensor (23).

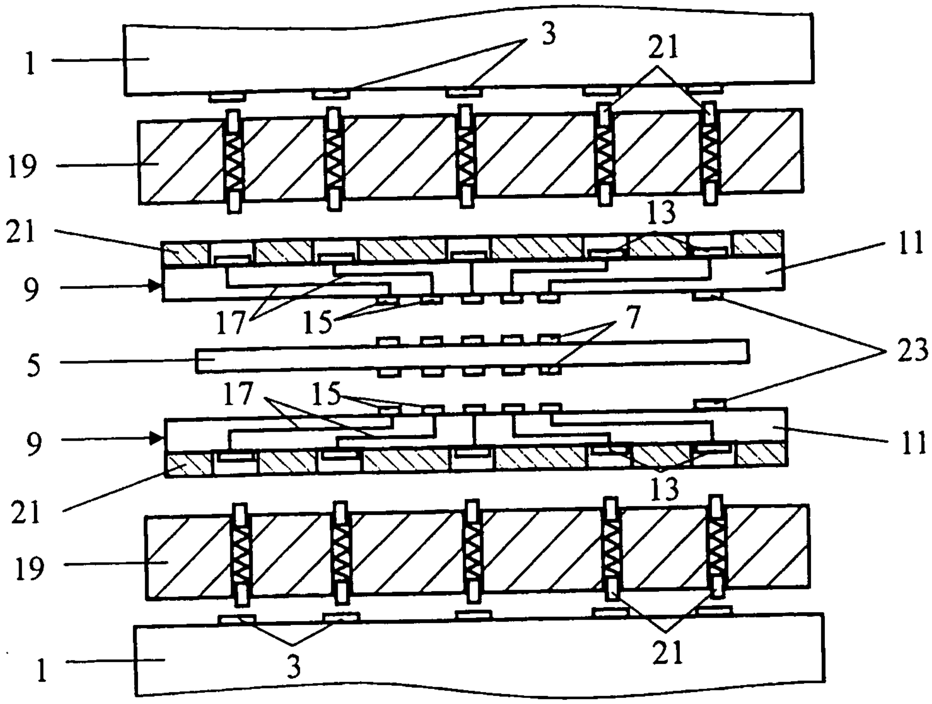


FIG. 1

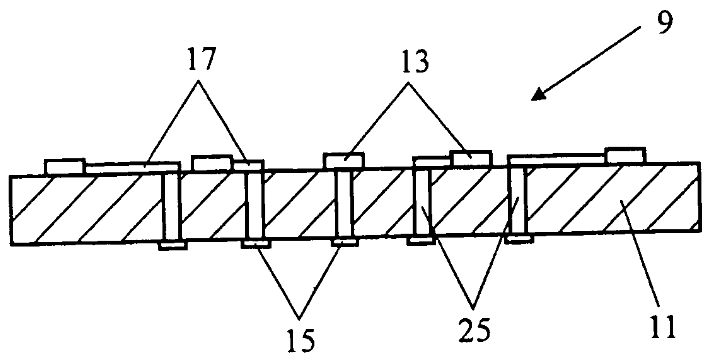


FIG. 2

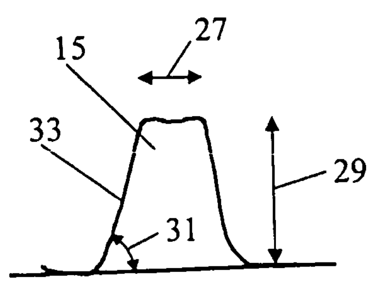


FIG. 3

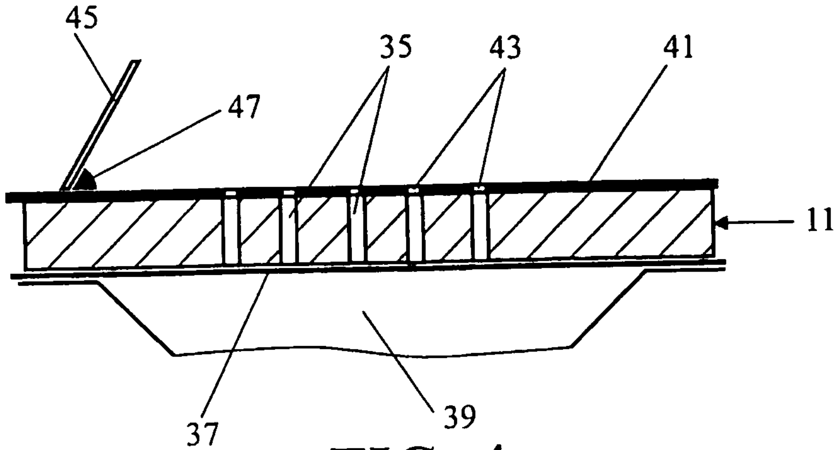


FIG. 4

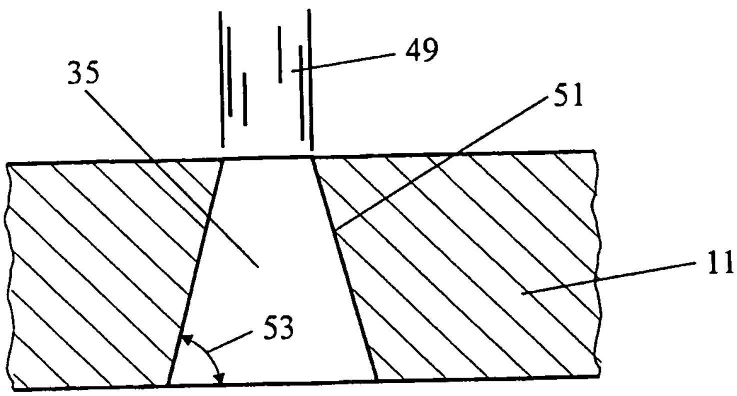


FIG. 5

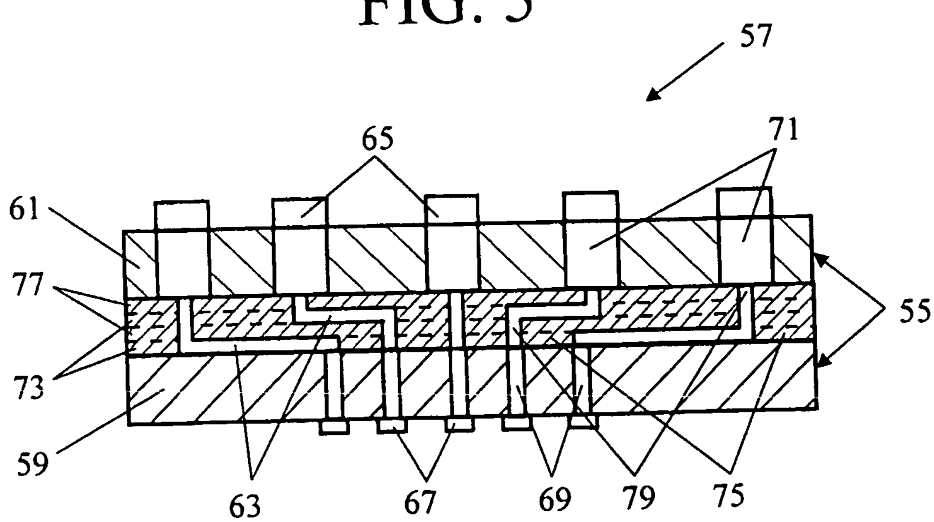


FIG. 6

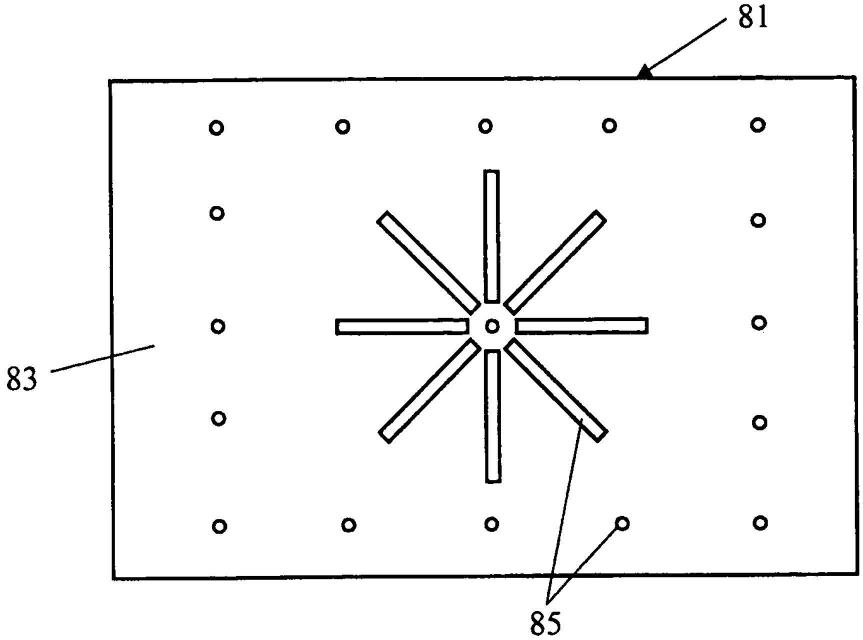


FIG. 7

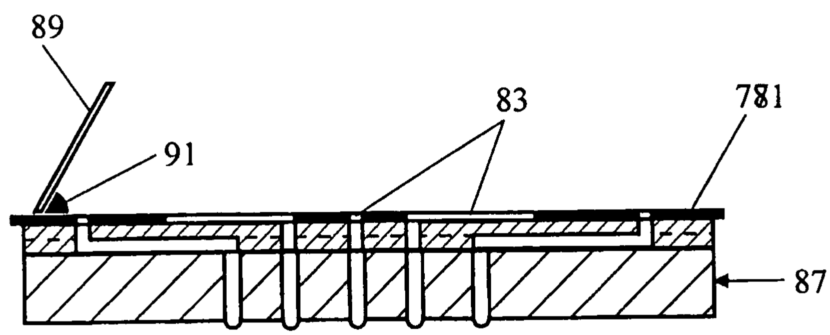


FIG. 8

INTERNATIONAL SEARCH REPORT

International Application No
PCT/NL 97/00616

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G01R3/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 030 318 A (RECHE) 9 July 1991 see column 1 - column 2 ---	1
Y	FR 2 529 406 A (LEP) 30 December 1983 see page 6 ---	1
A	EP 0 278 484 A (ARISTO) 17 August 1988 see claim 5 -----	1-20

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

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Date of the actual completion of the international search	Date of mailing of the international search report
9 January 1998	20/01/1998

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Hoornaert, W

INTERNATIONAL SEARCH REPORT

Information on patent family members

Int :ional Application No
PCT/NL 97/00616

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5030318 A	09-07-91	NONE	
FR 2529406 A	30-12-83	NONE	
EP 278484 A	17-08-88	DE 3704498 A DE 3883263 A	25-08-88 23-09-93